Decision Tree

**Experiment : 1**

**Classifier:** Decision Tree

**Cross- Validation fold:** 10

**Parameters:** DecisionTreeClassifier()

**Average Accuracy of 10 folds:** 77.1479774706

**Experiment : 2**

**Classifier:** Decision Tree

**Cross- Validation fold:** 10

**Parameters:** DecisionTreeClassifier( max\_leaf\_nodes=100,max\_depth=20)

**Average Accuracy of 10 folds:** 76.6692268305

**Experiment : 3**

**Classifier:** Decision Tree

**Cross- Validation fold:** 10

**Parameters:** DecisionTreeClassifier( max\_leaf\_nodes=100)

**Average Accuracy of 10 folds:** 76.8279569892

Perceptron

**Experiment : 1**

**Classifier:** Perceptron

**Cross- Validation fold:** 10

**Parameters:** Perceptron(penalty='l2', alpha=0.0001)

**Average Accuracy of 10 folds:** 86.4106502816

**Experiment : 2**

**Classifier:** Perceptron

**Cross- Validation fold:** 10

**Parameters:** Perceptron(penalty='l2', alpha=0.0001)

**Average Accuracy of 10 folds:** 86.8996415771

**Experiment : 3**

**Classifier:** Perceptron

**Cross- Validation fold:** 10

**Parameters:** Perceptron(penalty='l2', alpha=0.0001,class\_weight='balanced')

**Average Accuracy of 10 folds:** 86.8996415771

Neural Network

**Experiment : 1**

**Classifier:** Neural Network

**Cross- Validation fold:** 10

**Parameters:** MLPClassifier()

**Average Accuracy of 10 folds:** 96.0112647209

**Experiment : 2**

**Classifier:** Neural Network

**Cross- Validation fold:** 10

**Parameters:**MLPClassifier(hidden\_layer\_sizes=(50,45),activation='logistic',learning\_rate\_init=0.001)

**Average Accuracy of 10 folds:** 85.2867383513

**Experiment : 3**

**Classifier:** Neural Network

**Cross- Validation fold:** 10

**Parameters:**MLPClassifier(hidden\_layer\_sizes=(30,10),activation='tanh',learning\_rate\_init=0.001,solver='lbfgs',max\_iter=100)

**Average Accuracy of 10 folds:** 96.4823348694

Deep Learning

**Experiment : 1**

**Classifier:** Deep Learning

**Cross- Validation fold:** 10

**Parameters:**MLPClassifier(hidden\_layer\_sizes=(50,45,35,30,28,25,20),activation='identity',learning\_rate\_init=0.01)

**Average Accuracy of 10 folds:** 97.6036866359

**Experiment : 2**

**Classifier:** Deep Learning

**Cross- Validation fold:** 10

**Parameters:**MLPClassifier(hidden\_layer\_sizes=(20,20,20,20,20,20,20),activation='relu',learning\_rate\_init=0.01,solver='lbfgs')

**Average Accuracy of 10 folds:** 98.0875576037

**Experiment : 3**

**Classifier:** Deep Learning

**Cross- Validation fold:** 10

**Parameters:**MLPClassifier(hidden\_layer\_sizes=(30,30,20,20,10,10,5),activation='relu',learning\_rate\_init=0.01,solver='lbfgs',max\_iter=100)

**Average Accuracy of 10 folds:** 83.2437275986

SVM

**Experiment : 1**

**Classifier:** SVM

**Cross- Validation fold:** 10

**Parameters:** SVC()

**Average Accuracy of 10 folds:** 90.5709165387

**Experiment : 2**

**Classifier:** SVM

**Cross- Validation fold:** 10

**Parameters:** SVC(C=1,kernel='rbf',tol=0.001,cache\_size=200,degree=8)

**Average Accuracy of 10 folds:** 90.5709165387

**Experiment : 3**

**Classifier:** SVM

**Cross- Validation fold:** 10

**Parameters:** SVC(C=1,kernel='linear')

**Average Accuracy of 10 folds:** 91.6871479775

GaussianNB

**Experiment : 1**

**Classifier:** GaussianNB

**Cross- Validation fold:** 10

**Parameters:** GaussianNB()

**Average Accuracy of 10 folds:** 87.8469022017

LogisticRegression

**Experiment : 1**

**Classifier:** LogisticRegression

**Cross- Validation fold:** 10

**Parameters:** LogisticRegression()

**Average Accuracy of 10 folds:** 85.7680491551

**Experiment : 2**

**Classifier:** LogisticRegression

**Cross- Validation fold:** 10

**Parameters:** LogisticRegression (penalty='l1', tol=0.0001, C=1.5, solver='liblinear', max\_iter=500)

**Average Accuracy of 10 folds:** 85.6067588326

**Experiment : 3**

**Classifier:** LogisticRegression

**Cross- Validation fold:** 10

**Parameters:** LogisticRegression(penalty='l2', C=0.5, solver='sag', max\_iter=100)

**Average Accuracy of 10 folds:** 85.7680491551

KNeighbors Classifier

**Experiment : 1**

**Classifier:** KNeighborsClassifier

**Cross- Validation fold:** 10

**Parameters:** KNeighborsClassifier()

**Average Accuracy of 10 folds:** 84.8361495136

**Experiment : 2**

**Classifier:** KNeighborsClassifier

**Cross- Validation fold:** 10

**Parameters:**KNeighborsClassifier(n\_neighbors=9,algorithm='ball\_tree',weights='distance')

**Average Accuracy of 10 folds:** 87.2299027138

**Experiment : 3**

**Classifier:** KNeighborsClassifier

**Cross- Validation fold:** 10

**Parameters:**KNeighborsClassifier(n\_neighbors=15,algorithm='kd\_tree',weights='distance',leaf\_size=15)

**Average Accuracy of 10 folds:** 87.7035330261

Bagging Classifier

**Experiment : 1**

**Classifier:** Bagging Classifier

**Cross- Validation fold:** 10

**Parameters:** BaggingClassifier()

**Average Accuracy of 10 folds:** 78.425499232

**Experiment : 2**

**Classifier:** Bagging Classifier

**Cross- Validation fold:** 10

**Parameters:** BaggingClassifier(max\_features=2,max\_samples=500 ,bootstrap\_features=False,bootstrap=False )

**Average Accuracy of 10 folds:** 74.5622119816

**Experiment : 3**

**Classifier:** Bagging Classifier

**Cross- Validation fold:** 10

**Parameters:**BaggingClassifier(n\_estimators=50,bootstrap=True,bootstrap\_features=False)

**Average Accuracy of 10 folds:** 79.5366103431

RandomForest Classifier

**Experiment : 1**

**Classifier:** RandomForest Classifier

**Cross- Validation fold:** 10

**Parameters:** RandomForestClassifier()

**Average Accuracy of 10 folds:** 78.1054787506

**Experiment : 2**

**Classifier:** RandomForest Classifier

**Cross- Validation fold:** 10

**Parameters:** RandomForestClassifier(n\_estimators=30,bootstrap=True)

**Average Accuracy of 10 folds:** 80.6630824373

**Experiment : 3**

**Classifier:** RandomForest Classifier

**Cross- Validation fold:** 10

**Parameters:**RandomForestClassifier(n\_estimators=30,bootstrap=True,max\_features=2,max\_depth =10)

**Average Accuracy of 10 folds:** 80.821812596

AdaBoost Classifier

**Experiment : 1**

**Classifier:** AdaBoost Classifier

**Cross- Validation fold:** 10

**Parameters:** AdaBoostClassifier()

**Average Accuracy of 10 folds:** 90.5504352279

**Experiment : 2**

**Classifier:** AdaBoost Classifier

**Cross- Validation fold:** 10

**Parameters:** AdaBoostClassifier(n\_estimators=200,algorithm='SAMME')

**Average Accuracy of 10 folds:** 90.2304147465

**Experiment : 3**

**Classifier:** AdaBoost Classifier

**Cross- Validation fold:** 10

**Parameters:** AdaBoostClassifier(n\_estimators=100,algorithm='SAMME.R')

**Average Accuracy of 10 folds:** 91.523297491

GradientBoosting Classifier

**Experiment : 1**

**Classifier:** GradientBoosting Classifier

**Cross- Validation fold:** 10

**Parameters:** GradientBoostingClassifier()

**Average Accuracy of 10 folds:** 87.534562212

**Experiment : 2**

**Classifier:** GradientBoosting Classifier

**Cross- Validation fold:** 10

**Parameters:** GradientBoostingClassifier(n\_estimators=200,max\_depth=3)

**Average Accuracy of 10 folds:** 87.7035330261

**Experiment : 3**

**Classifier:** GradientBoosting Classifier

**Cross- Validation fold:** 10

**Parameters:**GradientBoostingClassifier(learning\_rate=0.001,max\_depth=5,random\_state=2,max\_features='sqrt')

**Average Accuracy of 10 folds:** 74.4188428059

**Analysis**

-> The best set of parameters for each classifier was obtained by changing values of the parameters and then checking the accuracy. The one that got highest accuracy were considered as the best parameters from the others logged in the table (best parameters are highlighted with blue color text in table).

-> We concluded from the above analysis that cross validation gives a higher accuracy as compared to normal testing.

-> According to the observation **Deep Learning** is the best classifier as it produces the best accuracy, though the training phase is the most complex and time consuming.